Weather Notes

A THUNDERSTORM SOUNDING

An area of thunderstorms developed over eastern Kansas, Iowa, and Missouri during the afternoon and evening of October 13 and early morning of October 14, 1954. Most of these thunderstorms formed ahead of and along a sharp cold front; however, their scattered locations, as well as other characteristics of these thunderstorms, do not permit an analysis of their occurrences along a single instability line. In connection with these thunderstorms, a special RAOB was requested from Columbia, Mo., for 0300 CST, October 14, 1954. Several features of this sounding are unusual. One purpose of this note is to point out some of these interesting features with a little more detail than is generally available in such cases. A more important purpose is to emphasize the importance of this type of sounding in connection with severe local storm research, in order that every effort will be made to evaluate similar soundings in a reasonable amount of detail. Also, it is hoped that RAOB observers will call such soundings to the attention of the Severe Local Storms Forecast Center.

A feature of the surface weather map for 0030 CST, October 14, of particular interest here, was a sharp cold front which extended south-southwestward from a low center in southwestern Wisconsin. At this time the cold front was just west of Columbia, the actual frontal passage occurring at Columbia at 0505 CST.

The plotted sounding to 400 mb. as computed from the original recorder record is shown in figure 1. Wind speeds to the nearest 5 knots (half barbs) and directions to the nearest 10° for the standard levels for this observation at Columbia are shown on the left in figure 1. The rate of ascent of the balloon from the surface to 604 mb. was near 950 ft./min., which is about average. Above this level, the ascension rate suddenly became much greater, and this rapid ascent continued to 436 mb. The depth of this layer is 8,890 ft., and the instrument traversed the distance in 3.2 minutes for an average ascension rate of 2,780 ft./min. Considering the layer, 604 to 436 mb., with the very rapid ascension rate, note that the temperature lapse rate was exceedingly stable through most of the layer, and it was capped by a layer 3,280 ft. deep which had a very steep lapse rate. The decrease of potential temperature through this upper layer was 9° C.

Such unusual lapse rates are usually considered as resulting from instrumental error, or, in the case of a very steep lapse rate through a dry layer, from the wet-bulb effect. The Instrument Division of the U. S. Weather Bureau has indicated that there is no obvious reason why the recorded temperatures through this layer should be questioned, since the instrument appeared to be functioning normally both above and below. Also, the original recorder record was sharp and clear, even though the ascent was so rapid that the baroswitch contacts were of only brief duration. Finally, it would seem unrealistic to attribute the steep lapse rate between 479 mb. and 423 mb. to a wet-bulb effect since the layer was over 3,000 feet thick and the air for some time prior to this was considerably less than saturated. Thus, it appears that these measured values are real.

This instrument was released at 0237 CST. The weather reported at 0228 CST was as follows: RS2 M50 ⊕ 2 1/2 TRW+054/66/64↗9/971/T SW and NW MOVG E FQT LTGIC-CG SW THRU N. Distant lighting had been continually reported from 1905 CST, October 13, until thunder was finally heard at the station at 0105 CST, October 14. Thunder with rain started at 0105 CST, and continued until 0559 CST. Pressure jumps were reported at 0053, 0448, and 0527 CST, October 14.

The cold front, with which these thunderstorms were associated, was moving eastward about 20 m. p. h. It is probable that this instrument was released into one thunderstorm that was surrounded by other thunderstorms. However, it cannot be ascertained whether the instrument remained within this thunderstorm to the 400-mb. level, or, if it did, what part of the thunderstorm was traversed by the instrument. Possibly the instrument was in and out of the thunderstorm at different times. Thus, from these data it cannot be determined whether the temperature gradients, particularly through the very steep and/or the very stable lapse rates, were being measured through the vertical or the horizontal. This problem is being studied in research at the Severe Local Storms Forecast Center as more and more soundings become available.

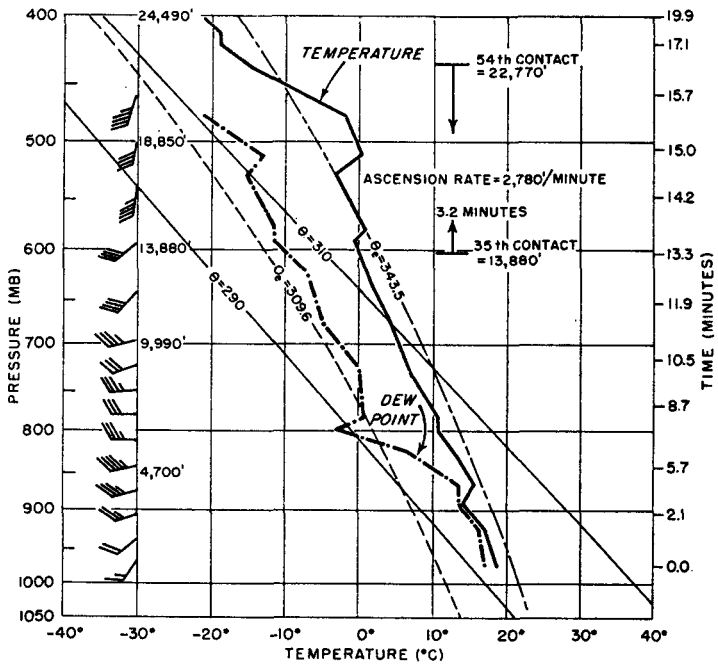

FIGURE 1.—Upper air soundings taken at Columbia, Mo., at 0237 CST, October 14, 1954. Wind speeds to the nearest 5 knots (half barbs) and directions to the nearest 10° for the standard levels are shown on the left. Time after release is shown on the right.

In this research, several similar soundings have been noted when the instrument was released in the vicinity of thunderstorm activity. Perhaps these unusual lapse rates in or near thunderstorms should not be surprising. But there are at least two features of such observations that are worthy of note. The more important of these is that direct observational data on updraft strength as measured from the ascension rate, admittedly a gross estimate but still better than nothing, are not currently being included in the coded RAOB message. Indeed, such data are not usually evaluated. Finally, forecasters and observers alike should be cautious about terming unusual temperature data as "doubtful" or "missing" unless malfunctioning of the instrument is apparent.—*Harold C. McComb, WBAS, Kansas City, Mo., and Robert G. Beebe, WBFC, Kansas City, Mo.*